O-Ring Squeeze, Gland Fill and Stretch

Compression (squeeze), gland fill and installed stretch of an O-ring seal from its section and inside diameter, the gland depth and width and the groove diameter.

Method: O-ring gland geometry: squeeze; fill and stretch with constant rubber volume

Input parameters

Unit system: SI

Parameter	Value	Unit
O-ring cross-section diameter	3.5300	mm
O-ring inside diameter	44.200	mm
Gland depth (radial, including clearance)	2.8000	mm
Groove width	4.7000	mm
Diameter the O-ring is stretched over (groove root for a piston; 0 to ignore)	45.000	mm

Calculated results

Parameter	Value	Unit
Compression (W − h)/W	20.680	%
Inside diameter stretch	1.8100	%
Cross-section reduced by stretch (constant volume)	3.5018	mm
Squeeze with the reduced cross-section	20.041	%
Gland fill (O-ring area / groove area)	73.184	%

Notes for this case

• Typical targets: 15–30 % squeeze for static seals, 10–20 % for dynamic; gland fill below about 75–85 % to leave room for swelling and expansion; stretch below about 5 %.

Formula and method

$$\text{squeeze} = \frac{W - h}{W}, \quad \text{stretch} = \frac{d_g}{d_1} - 1, \quad W'^2\,[d_1(1+\text{stretch}) + W'] = W^2(d_1 + W), \quad \text{fill} = \frac{\pi W'^2/4}{hb}$$

Variables

W	O-ring cross-section diameter	m
d_1	O-ring inside diameter	m
h	Gland depth (radial, including clearance)	m
b	Groove width	m
d_g	Diameter the O-ring is stretched over (groove root for a piston; 0 to ignore)	m
squeeze	Compression (W − h)/W	-
stretch	Inside diameter stretch	-
W'	Cross-section reduced by stretch (constant volume)	m
$\text{squeeze}'$	Squeeze with the reduced cross-section	-
fill	Gland fill (O-ring area / groove area)	-

Method and standards

O-ring gland geometry.

Assumptions and limits

- Constant rubber volume; tolerances not included (check the extremes).

References

O-ring gland geometry: squeeze, fill and stretch with constant rubber volume

Report details

Report reference	FCC-MQDW-1Z9A (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/machine-design/o-ring-squeeze-gland-fill

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.